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(71) Applicants  
 Klöckner-Humboldt-  
 Deutz Aktiengesellschaft,  
 5000 Cologne 80,  
 German Federal Republic.  
 (72) Inventors  
 Gottfried Moser,  
 Hermann-Josef Komp,  
 Toni Höller,  
 Karl Tullius,  
 Jan Pank.  
 (74) Agents  
 Bromhead & Co.

## (54) Disc brake

(57) A disc brake, has a disc (6) mounted rotationally fast but axially displaceably on a shaft (1) and enclosed by a casing (30, 36), and at least one pair of brake pads (15, 16), one pad (16) of which is stationary whilst the other pad (15) is movable axially to engage

and move the disc, the brake also having the following features:

- (a) in order to facilitate pad removal the casing is provided with one or more openings (39, 40) whereby the pads are movable in a direction generally tangential to the disc;
- (b) in order to facilitate cooling of the brake disc, the disc is provided with radial air feed ducts (13);
- (c) in order to supply air to inlet apertures (17) of ducts (13) the casing is provided with one or more openings (37) through which air can flow axially into the casing towards the inlet apertures (17); and
- (d) the or each opening (39, 40) in the casings provided for the insertion and withdrawal of a brake pad serves also as an outlet aperture for the cooling air ducted through the brake disc. The disc brake may be combined with a drum brake acting as a parking brake.

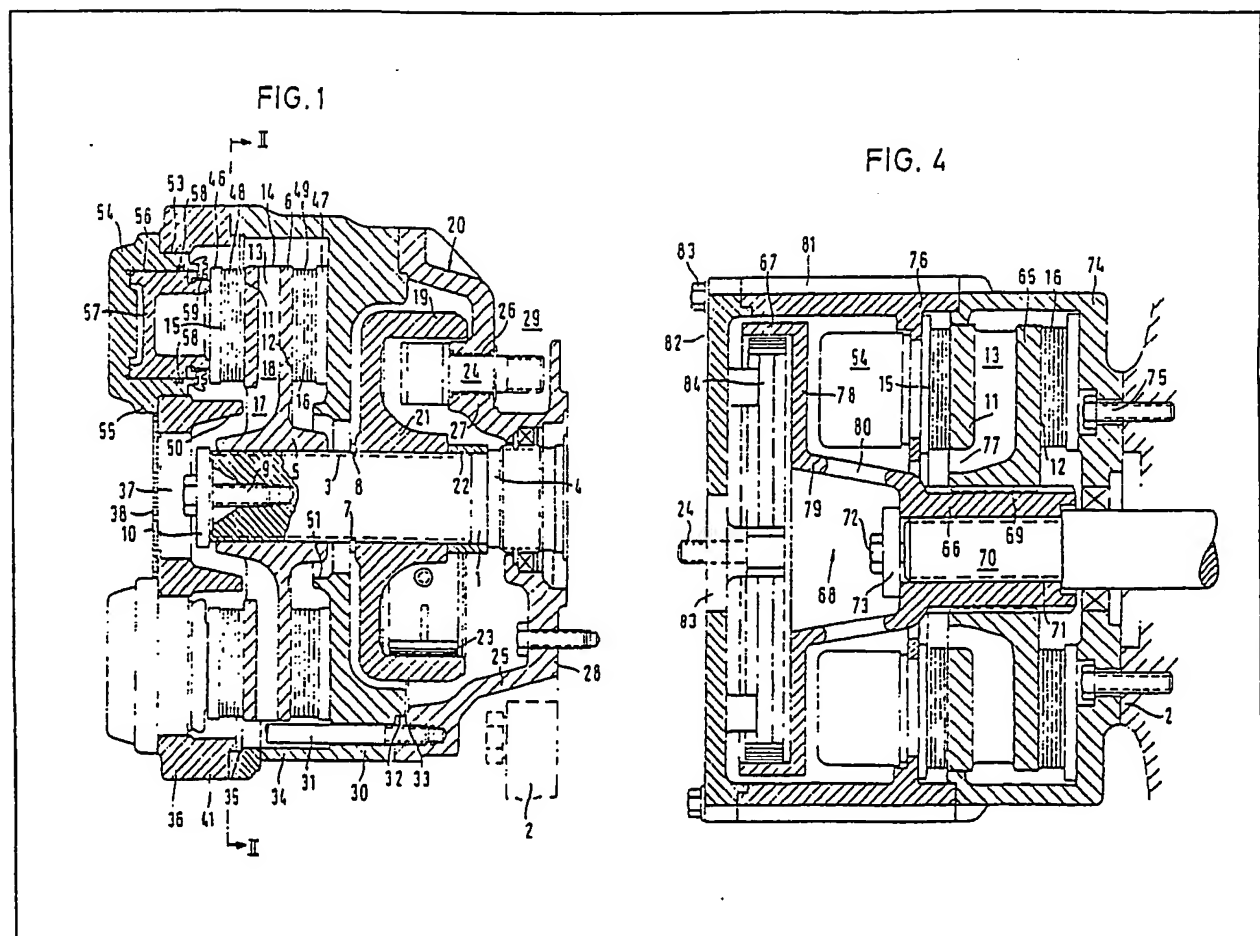


FIG. 1

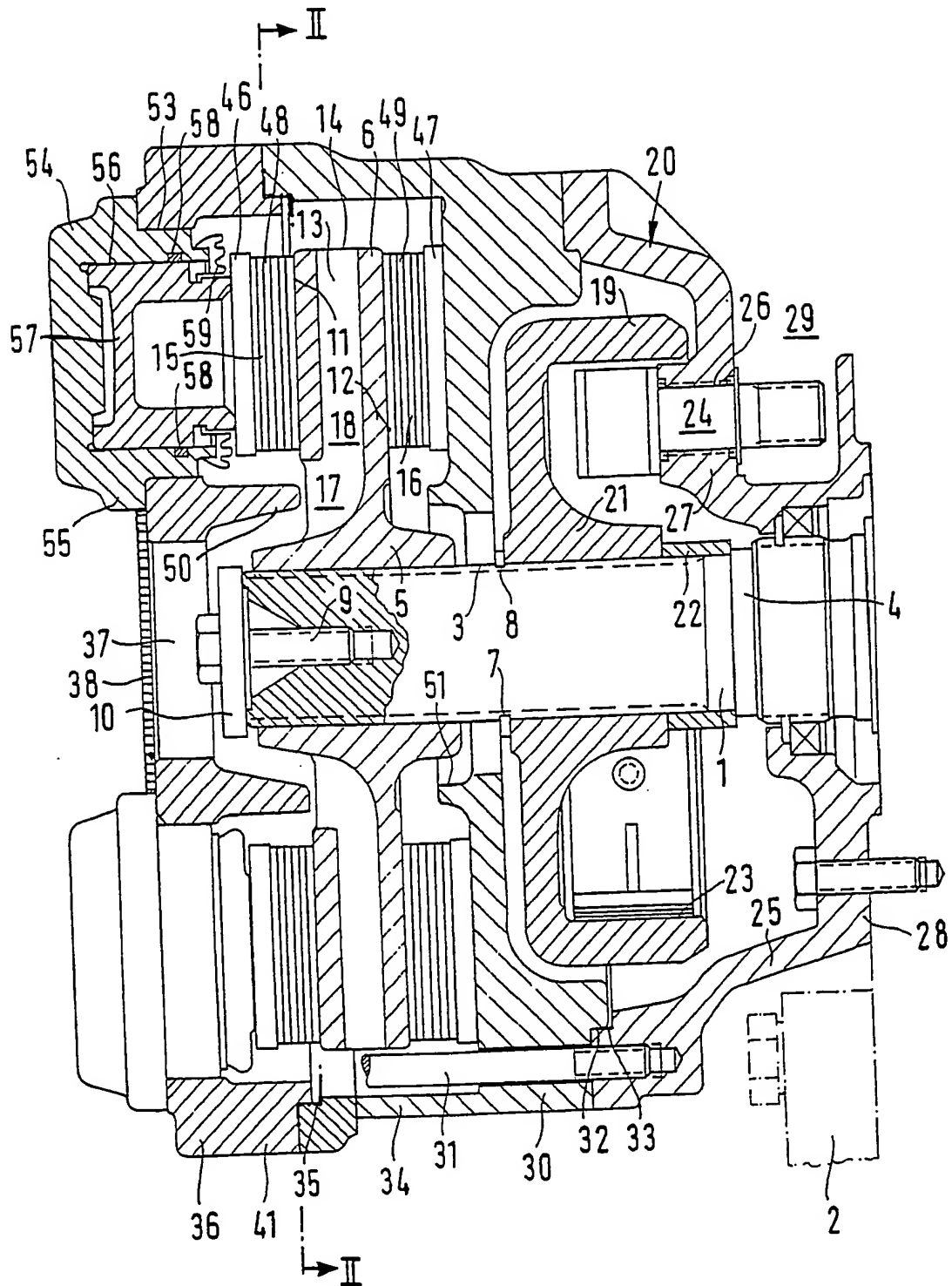


FIG. 2

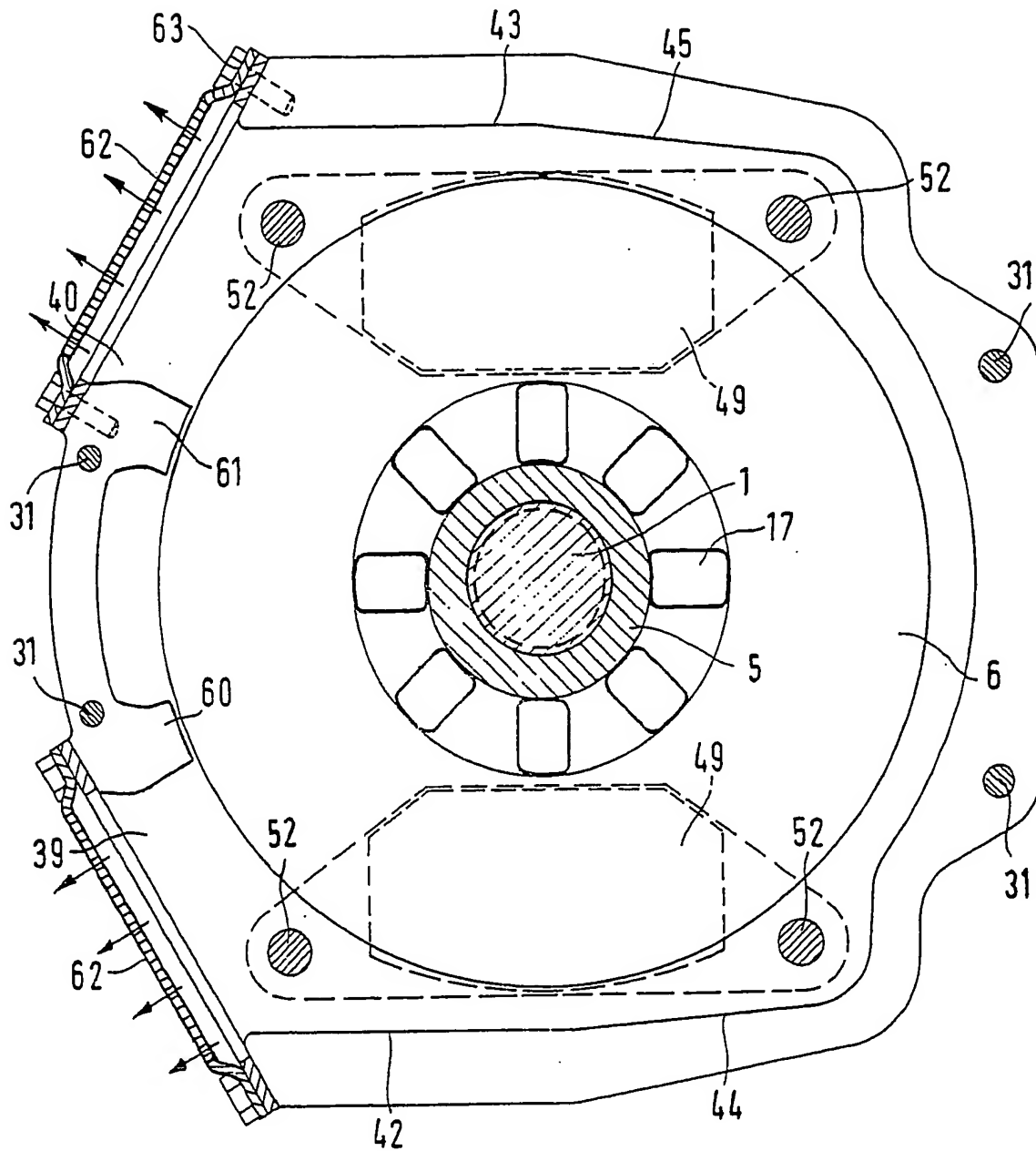
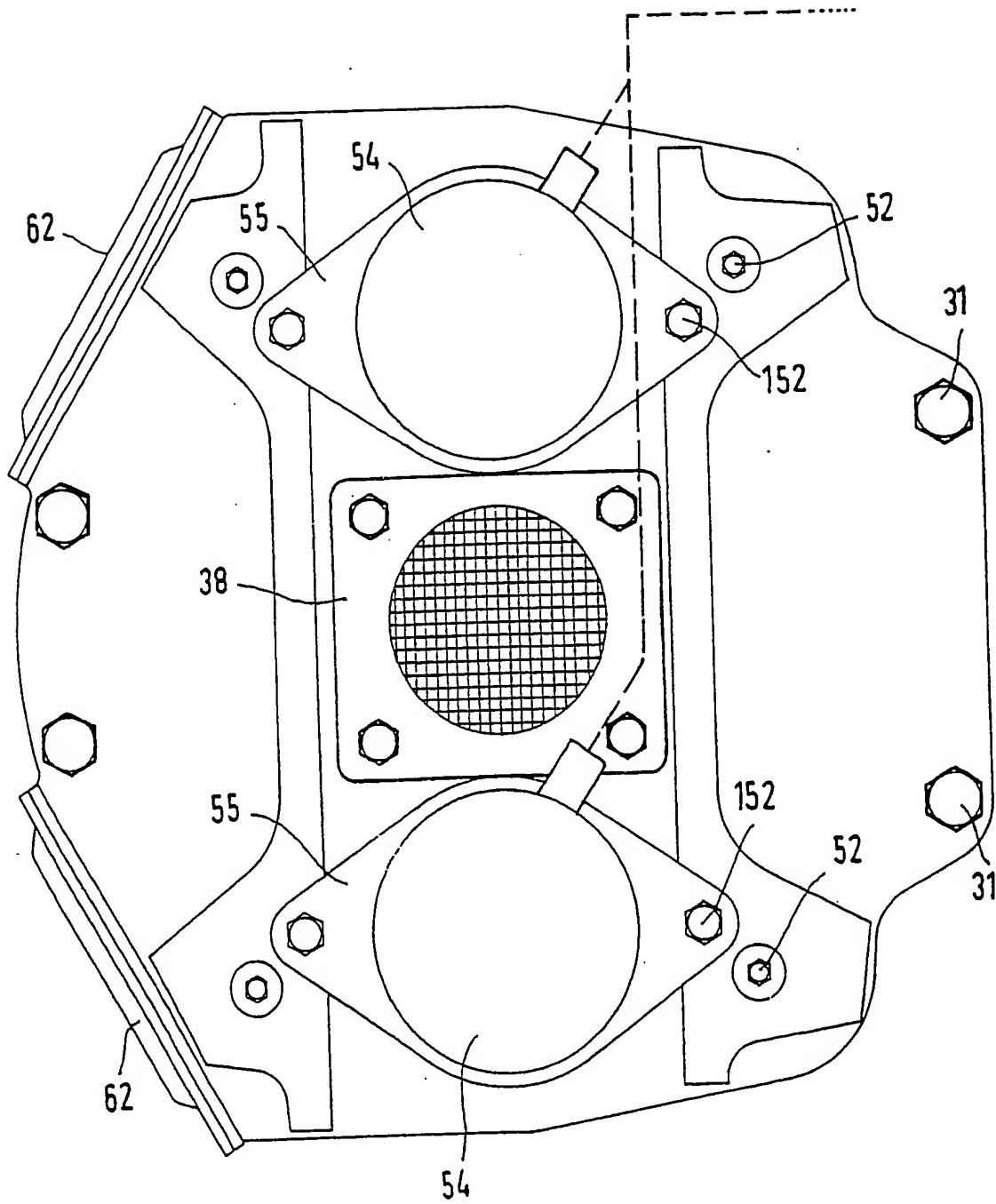
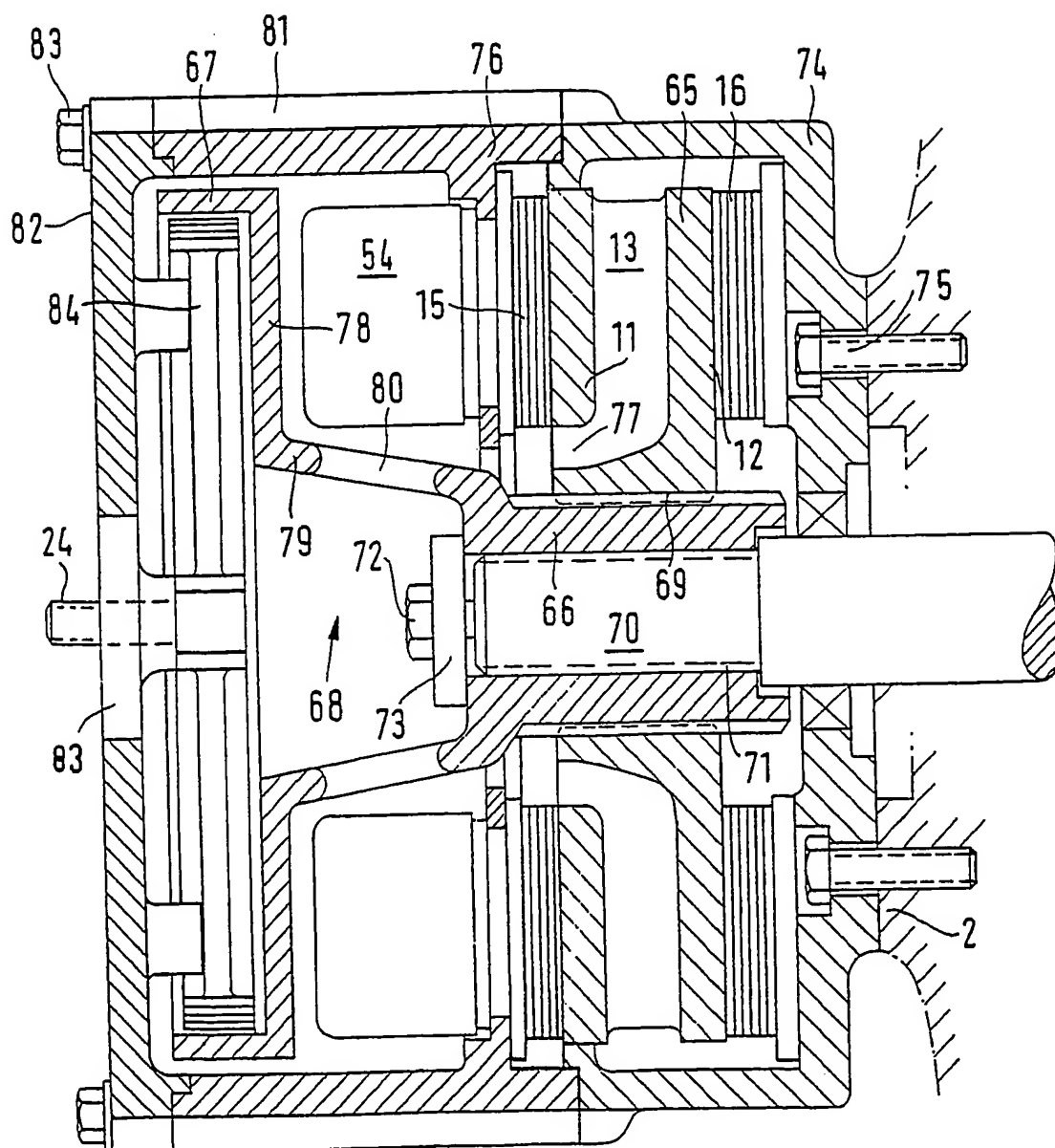


FIG. 3



4/4

FIG. 4



## SPECIFICATION

### Disc brake

5 This invention relates to a disc brake, e.g. a spot type disc brake, which is particularly suitable for motor vehicles of the kind used in the agricultural and/or construction industries. More specifically, it is directed to a disc brake having a brake disc mounted  
10 rotationally fast but axially displaceable on a brake shaft and enclosed substantially all-round by a casing, and at least one pair of brake pads between which the disc is to be clamped during braking, the pads being directly or indirectly supported in the  
15 casing so that one pad of the pair is stationary whilst the other is movable to engage the disc.

One of the problems arising in connection with a spot type disc brake of the aforementioned kind, particularly if the brake is mounted on a brake shaft -  
20 which projects from a drive axle housing - of an intermediate transmission between a differential gear and the drive shafts of a drive axle, is, in view of the small axial space usually available between the brake shaft and the drive shafts, to construct the disc brake so that it has adequate stopping power, and is  
25 suitably cooled. Parallel with this problem is the further problem of making certain that the brake gaps between the brake disc and the brake pads are cleaned by air.

30 Another problem with such a disc brake is that, in spite of the restricted constructional volume of the brake, it is desirable that its brake pads can be inspected and/or changed readily without dismantling the brake, even when the disc and brake pads  
35 are encased to the greatest possible extent to protect them.

These problems which arise in disc brakes of the kind referred to in the opening paragraph of the Specification are solved according to the invention  
40 by a combination of the following features:

(a) in order to facilitate inspection and/or changing of the pads, the casing is provided with one or more insert openings by way of which the pads can  
45 be inserted into and withdrawn from the casing in a direction generally tangential to the disc;

(b) in order to facilitate cooling of the brake disc, the disc is provided with air feed ducts having inlet apertures disposed radially inwardly of the pads, the  
50 air feed ducts extending generally radially towards the disc outer periphery;

(c) in order to supply air to the air duct inlet apertures, the casing is provided with one or more openings through which air can flow axially into the  
55 casing towards the inlet apertures; and

(d) the or each opening in the casings provided for the insertion and withdrawal of a brake pad serves also as an outlet aperture for the cooling air  
60 ducted through the brake disc.

The result of this solution is that a disc brake, e.g. a spot type disc brake, is feasible even with the highest possible gear ratio of a one-step intermediate transmission of a drive axle and that the brake disc and

braking power and efficient cooling, can despite being encased in a small casing be constructed not only at particularly low cost but also in such a way as to facilitate servicing.

70 In a preferred embodiment, the inlet apertures of the air feed ducts of the brake disc lie on a main side face of the disc, and outlet apertures of the air feed ducts are formed in the peripheral, edge face of the disc to direct air radially outwardly.

75 Usually, application of the brake takes place during forward driving. Thus, the brake gap between disc and pads will be scoured particularly effectively and the brake disc cooled if the or each insert opening of the pads has a mouth disposed in a plane  
80 parallel to a plane tangential to the brake disc.

It is also advantageous for the effective scouring of the gaps between the brake disc and the brake pads if one or more spacing fillets or the like are arranged, spaced over the circumference of the disc, in the  
85 casing between the insert openings for the brake pads.

In one embodiment the casing comprises a plurality of axially adjacent portions, two of said portions meeting in the region of the movable brake pad, one of the two casing portions accommodating a cylinder of a piston-and-cylinder assembly for moving the movable brake pad, such casing portion mating with the other casing portion to centre the two casing portions with respect to each other, the  
90 cylinder comprising a component inserted in an opening in an end wall of the said one casing portion and having a flange abutting the said end wall.

For the sake of ease of inspection and servicing it is also advantageous if the insert openings for the  
100 brake pads are, viewing the brake in the axial direction, located on one side of the periphery of the casing.

In order to facilitate insertion of the brake pads into the casing portion serving to house them, guide members or surfaces serving to guide or support brake pads during insertion of the pads into the casing may be arranged in or on the casing.

If a drum brake operable as a parking brake is arranged axially spaced from the brake disc on the  
110 brake shaft, then the casing may comprise a plurality of axially adjacent portions, the drum brake being partially surrounded by one of said casing portions which abuts another casing portion that surrounds the brake disc. In this instance, it is advantageous for  
115 a space-saving construction of the combined brake arrangement and for the ventilation of the drum brake if the casing portion surrounding the brake disc is provided, in the vicinity of the hub of the brake disc, with a central opening having a diameter  
120 greater than that of the hub of the brake disc. It is further advantageous if the casing portion partially surrounding the brake drum of the drum brake is provided with one or more, preferably tangentially arranged, apertures for the egress of the air serving  
125 to cool and clear the drum brake.

In another embodiment a drum brake co-axial with the brake disc and operable as a parking brake is provided axially spaced from the brake disc, the brake drum of the parking brake being disposed in

between a cylindrical wall of the brake drum and its hub being provided with radially and/or axially extending air inlet apertures. In this instance, it will be advantageous for air-feeding and constructional purpose if said portion of the brake drum comprises a transverse wall or web and a bell-shaped part terminating in the hub. This will lead to a particularly low-cost arrangement for the brake disc if the latter is mounted rotationally fast yet axially displaceably on the hub of the brake drum. A particular advantage of such an arrangement is that the brake disc can be clamped without the risk of its inner edge being distorted since the diameter of the hub relative to that of the brake disc is comparatively large.

In an embodiment designed for easy servicing and for providing a particularly space-saving brake unit, a brake cylinder for operating the movable brake pad is disposed between the brake drum of the parking brake and a portion of the casing surrounding the brake disc.

Further, with such an arrangement it is particularly advantageous if for casting and other production purposes the portion of the casing surrounding the brake disc is adapted to be connected to a housing serving to support the shaft, such casing portion abutting a further casing portion which surrounds the brake drum and mounts the brake cylinder.

Preferably, the casing portion mounting the brake cylinder and surrounding the brake drum abuts a casing portion which serves as an anchor plate disposed in front of the brake drum and mounting the drum brake shoes. This provides a low-cost mounting of the brake operating shaft of the parking brake.

Further characteristics, features and advantages of the present invention may be gathered from the following description of the drawings which illustrate two examples of the invention and in which:

*Figure 1* is a longitudinal cross-sectional view of a spot type disc brake according to the invention;

*Figure 2* is a transverse cross-sectional view of the disc brake shown in *Figure 1* taken on the line II-II IN *Figure 1*;

*Figure 3* is a top view of the disc brake of *Figure 1*; and

*Figure 4* is a cross-sectional view of another disc brake according to the invention.

In the embodiment illustrated in *Figures 1* to *3*, a shaft 1, rotation of which is to be braked, extends from a drive axle housing 2. The shaft 1 is a shaft of an intermediate transmission - not illustrated - disposed between a differential and a drive shaft of a drive axle. The intermediate shaft 1 is provided with a drive spline 3 terminating adjacent a shoulder 4. A brake disc 6 having a hub 5 is mounted rotationally fast yet axially displaceably on the splined shaft 1.

The maximum axial displacement of the brake disc 6 is determined in one direction by a circlip 8 held in a groove 7 of the shaft 1 and in the other direction by a washer 10 fastened to the shaft 1 by means of a bolt 9. The body of the brake disc 6 is provided between its main side faces, 11, 12, with circumferentially spaced apart radially extending cooling air feed ducts 13 terminating at their outer ends in radial

edge of the disc. Each of the air feed ducts 13 terminates at its inner end in an axially extending duct 17 which opens onto the face 11 of the disc 6 at a location between the hub 5 and an axially movable brake pad 15, which pad is arranged to engage disc face 11. A radially and axially fixed or stationary brake pad 16 is positioned to be engaged by the brake face 12 when the pad 15 moves the disc 6 axially. The air feed ducts 13 are separated from each other by curved or arched transverse webs 18.

In addition, a brake drum 19 of a parking brake 20 is mounted fast against rotation and axial displacement on the shaft 1 between the circlip 8 and the shoulder 4. The brake drum 19 has a hub 21 which is axially restrained at its end opposite the circlip 8 by a ring 22 disposed between the shoulder 4 and the hub 21. A brake casing portion 25 serves to support the brake shoes 23 of the parking brake and for mounting a brake operating shaft 24 thereof. The casing portion 25 may be regarded as an adapter or connector casing portion since it is disposed between the rest of the casing and the housing 2. The adapter casing portion 25 includes an anchor plate 27 for supporting the brake shaft 24 and also includes a flange 28 for fastening it to the drive axle housing 2. There is a gap 29 between the anchor plate 27 and the flange 28 for an actuating lever - not illustrated - of the parking brake 20, the lever being connected to the brake operating shaft 24.

A portion 30 of the brake casing abuts the adapter casing 25 and is centrally positioned against it by a shoulder 33 on the adapter casing 25. The brake casing portion 30 includes a cylindrical wall 34 surrounding the brake disc 6 and having a centering shoulder 35 for engaging a shield-like brake casing portion 36, the portion 36 being provided with a preferably central axially arranged air inlet aperture 37. Preferably, the shield-like casing portion 36 is fastened directly to the adapter casing 25 by bolts 31, the casing part 30 being clamped between the casing portions 36 and 25.

If the brake is installed in a vehicle likely to be exposed to the effect of considerable amounts of dust or dirt, then the air inlet aperture 37 may be covered by an inlet filter 38 which will be bolted to the brake casing portion 36.

As seen in *Figure 2*, i.e. viewing the brake axially, the casing is provided, on one side of its periphery, with two openings 39, 40 extending to a web 41 of the shield-like brake casing portion 36. The openings 39, 40 are formed in the portions 36 and 30 of the casing and the web 41 merges with tangential guide surfaces 42 and 43 each of which terminates in a slop 44 and 45 respectively. The tangential guide surfaces serve for tangentially guiding and/or supporting the brake pads 15, 16 (comprising lining holders 46, 47 and brake linings 48, 49) during insertion of the pads tangentially into the casing. To facilitate insertion and withdrawal of the brake pads into and from their operative positions shown in *Figure 2*, the shield-like casing portion 36 is provided, in the region of the air inlet aperture 37 between the brake pad 15 and the hub 5, with a tangentially extending guide rib 50. Likewise, a tangentially extending guide rib 51 is



casing portion 30 between the latter and the hub 5. The ribs 50, 51 are described as extending tangentially because they have surfaces which lie parallel to the surfaces 43, 42, which surfaces lie parallel to a

5 tangent to disc 6. The brake pads 15, 16 are secured tangentially in their operative positions by means of bolts 52. A brake cylinder 54 having a flange 55 is inserted into a bore 53 in an end wall of the shield-like casing portion 36 and is fastened to it by  
10 means of bolts 52 as may be seen in Figure 3. However, the bolts 52 could instead be used for fastening the brake cylinder 54. There are in fact two pairs of the pads 15, 16 and two brake cylinders 54. Each brake pad 15 is associated with a piston 57 of  
15 respective brake cylinder 54 so that the pads 15 can be moved axially into engagement with the brake disc 6 which is in turn moved axially into engagement with the brake pads 16 to clamp the disc 6 between the pads. Each brake piston 57 is sealed in  
20 the cylindrical bore 56 by means of a sealing ring 58 located in a groove 59 of the brake cylinder 54. Further, a dust seal 59 tightly fastened to each piston 57 and to the shell of each brake cylinder 54.

In order to scour, i.e. clean with air, very thoroughly the brake gaps between the brake pads 15 and 16  
25 and the brake disc 6, spacing fillets 60 and 61 respectively are arranged, circumferentially spaced from one another, between the openings 39, 40 in the casing and the web 41 respectively. For protection  
30 against dust, each of the two openings 39, 40 may be covered by a filter 62 fastened by means of bolts 63 to the casing portion 30 and, respectively, the shield-like casing portion 36. The mouth of each opening 39, 40 lies in a plane parallel to a plane  
35 tangential to the disc 6. The openings 39, 40 serve not only for insertion and withdrawal of the brake pads, but also for the egress of air passing over or through disc 6.

The brake disc 65 in the embodiment illustrated in  
40 Figure 4 is mounted not directly on the shaft 70 but instead is mounted via a splined connection 69 on the hub 66 of a brake drum 67 of a parking brake. The hub 66 is connected to the shaft 70 by means of a spline 71. The hub 66 is secured, fast against axial  
45 displacement, by means of a bolt 72 and a washer 73 to the intermediate shaft 70. Unlike the previously described construction, the casing portion 74 surrounding the brake disc 65 forms, in the embodiment illustrated in Figure 4, the adapter casing  
50 portion and is fastened by bolts 75 to the drive axle housing 2. The casing portion 74 surrounding the brake disc is bolted to a cup-shaped casing portion 76 serving to house the opposed brake cylinders 54 which are arranged to act axially on the brake pads  
55 15. The casing portion 74 like the casing portion 76, and corresponding to the casing portions 30 and 36 respectively, are provided in the region of the brake pads 15, 16 with openings 39, 40 for insertion and withdrawal of the brake pads and for the egress of  
60 the air sucked through the brake disc 65 across a central air inlet aperture 77 in the web of the casing portion 76. Likewise, each brake cylinder 54 passes through a wall of the casing portion 76. Further, the brake pads 15, 16 tangentially tightly secured in the

bolts 52.

The brake drum 67 of the parking brake 68 is joined integrally by a web-like wall 78 to a bell-shaped part 79 terminating in the hub 66. The  
70 bell-shaped part 79 is provided with air inlet apertures 80. The parking brake 68 is surrounded by a cylindrical wall 81 of the casing portion 76 of the brake drum 67. Bolts 183 serve to bolt casing portion 82 to the casing portion 74 with the interposi-  
75 tion of casing portion 76. The casing part 82 is provided with an air-inlet aperture 83 which may be covered by a filter 38. The casing part 82 serves both as an end shield and as an anchor plate for mounting a brake operating shaft - not illustrated - and the  
80 brake shoes 84 of the parking brake 68.

The brake disc 6 in the embodiment illustrated in Figures 1 to 3 could be mounted on a portion of the hub of the brake drum 19, or on an adjoining specially provided hub portion. An advantage of  
85 such an arrangement is that edge distortion of the brake disc 6 or stress caused by heat can largely be eliminated.

In either of the embodiments described the casing portion which partially surrounds the brake drum of  
90 the drum brake can be provided with one or more, preferably tangentially arranged, apertures for the egress of the air serving to cool and clean the drum brake.

## 95 CLAIMS

1. A disc brake, for example a spot type disc brake, particularly suitable for a motor vehicle of the kind used in the agricultural and/or construction industries, including a brake disc mounted rotationally fast but axially displaceably on a brake shaft and enclosed substantially all-round by a casing, and at least one pair of brake pads between which the disc is to be clamped during braking, the pads being  
100 directly or indirectly supported in the casing so that one pad of the pair is stationary whilst the other pad is movable axially to engage the disc, the brake having a combination of the following features:

(a) in order to facilitate inspection and/or changing of the pads, the casing is provided with one or more insert openings by way of which the pads can be inserted into and withdrawn from the casing in a direction generally tangential to the disc;

(b) in order to facilitate cooling of the brake disc, the disc is provided with air feed ducts having inlet apertures disposed radially inwardly of the pads, the air feed ducts extending generally radially towards the disc outer periphery;

(c) in order to supply air to the air duct inlet apertures, the casing is provided with one or more openings through which air can flow axially into the casing towards the inlet apertures; and

(d) the or each opening in the casings provided for the insertion and withdrawal of a brake pad  
125 serves also as an outlet aperture for the cooling air ducted through the brake disc.

2. A disc brake according to claim 1, in which the inlet apertures of the air feed ducts of the brake disc lie on a main side face of the disc, and in which outlet

peripheral edge face of the disc to direct air radially outwardly.

3. A disc brake according to claim 1 or claim 2, in which the or each brake pad insert opening in the casing has a mouth disposed in a plane parallel to a plane tangential to the brake disc.

4. A disc brake according to any one of claims 1 to 3, in which one or more spacing fillets or the like are arranged, spaced over the circumference of the disc, in the casing between the casing insert openings, for the brake pads.

5. A disc brake according to any preceding claim, in which the casing comprises a plurality of axially adjacent portions, two of said portions meeting in the region of the movable brake pad, one of the two casing portions accommodating a cylinder of a piston-and-cylinder assembly for moving the movable brake pad, such casing portion mating with the other casing portion to centre the two casing portions with respect to each other, the cylinder comprising a component inserted in an opening in an end wall of the said one casing portion and having a flange abutting the said end wall.

6. A disc brake according to any preceding claim, in which the insert openings for the brake pads are, viewing the brake in the axial direction, located on one side of the periphery of the casing.

7. A disc brake according to any preceding claim, in which guide members or surfaces serving to guide or support brake pads during insertion of the pads into the casing are arranged in the casing or on the casing.

8. A disc brake according to any preceding claim, in which a drum brake operable as a parking brake is arranged axially spaced from the brake disc on the brake shaft, the casing comprising a plurality of axially adjacent portions, the drum brake being partially surrounded by one of said casing portions which abuts another casing portion that surrounds the brake disc.

9. A disc brake according to claim 8, in which the said casing portion surrounding the brake disc is provided, in the vicinity of the latter's hub, with a central opening having a diameter greater than that of the hub of the brake disc.

10. A disc brake according to claim 8 or claim 9, in which the said casing portion partially surrounding the brake drum of the drum brake is provided with one or more, preferably tangentially arranged, apertures for the egress of the air serving to cool and clean the drum brake.

11. A disc brake according to any one of claims 1 to 7, in which drum brake co-axial with the brake disc and operable as a parking brake is provided axially spaced from the brake disc, the brake drum of the parking brake being disposed in front of the brake disc, a portion of the brake drum between a cylindrical wall of the brake drum and its hub being provided with radially and/or axially extending air inlet apertures.

12. A disc brake according to claim 11, in which said portion of the brake drum comprises a transverse wall or web and a bell-shaped part terminating in the hub

claim, in which the brake disc is mounted rotationally fast but axially displaceably on the hub of the brake drum which is mounted on the shaft.

14. A lined axial disc brake according to claim 11 or claim 12, or according to claim 13 when appended to claim 11 or 12, in which a brake cylinder for operating the movable brake pad is disposed between the brake drum of the parking brake and a portion of the casing surrounding the brake disc.

15. A disc brake according to claim 14, in which the portion of the casing surrounding the brake disc is adapted to be connected to a housing serving to support the shaft, such casing portion abutting a further casing portion which surrounds the brake drum and mounts the brake cylinder.

16. A disc brake according to claim 15, in which the casing portion mounting the brake cylinder and surrounding the brake drum abuts a casing portion which serves as an anchor plate disposed in front of the brake drum and mounting the drum brake shoes.

17. A disc brake according to claim 16 in which the anchor plate is provided with an axially extending air inlet aperture.

18. A disc brake according to any preceding claim, in which a filter-like component covers air inlets and/or air outlets.

19. A spot type disc brake substantially as described herein with reference to Figures 1 to 3 or Figure 4 of the accompanying drawings.

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